

PHYCOLOGICAL STUDIES FROM THE
MARINE SCIENCE INSTITUTE
NAHANT, MASSACHUSETTS¹

I. INTRODUCTION AND PRELIMINARY
TABULATION OF SPECIES AT NAHANT

E. E. WEBBER

This is the initial paper in a series dealing with the attached marine algae at Nahant. These observations and studies began in the summer of 1968, and are continuing.

The present paper summarizes the history of marine phycology in New England; this summary is followed by citations emphasizing recent research dealing with the local marine algal vegetation. A tabulation of the species found in the vicinity of Nahant is then presented. No attempt is made at this time to discuss the plants listed since discussions of specific taxa will constitute the topics of future papers in this series.

INTRODUCTION

Published accounts of the marine algal vegetation of New England began essentially in the late 1800's. The Nahant area figured prominently in these studies. The efforts of such local investigators as Farlow, Collins, Davis, and others (see Taylor, 1957 for a thorough bibliography), extending from about 1880 to the early part of this century, resulted in the cataloging of the seaweeds common along the open coast. Early field work emphasized the macroscopic algae of the littoral and upper littoral zones of the shoreline. Study of New England marine algae progressed through the 1920's and 1930's, culminating in the appear-

¹Contribution No. 24 from the Marine Science Institute. I wish to thank Dr. A. C. Mathieson for his valuable suggestions during the writing of this paper.

ance of Taylor's (1937) phycological survey of the northeastern coast of North America. Twenty years later, recognizing the need for both an updating of information and the inclusion of new data, Taylor published a revision (1957) of his volume. This major contribution is still the basic reference for phycologists interested in the benthic marine algae of our northeastern coast.

From 1957 to the present, marine phycological studies in New England have progressed rapidly along several fronts. The utilization of SCUBA diving equipment has enabled the marine phycologist to study more accurately the heretofore inaccessible sublittoral zone; in addition, this technique has permitted field research on a year-round basis. The following may be cited as recent examples of SCUBA-aided research in New England waters: Lamb & Zimmermann, 1964; Hehre & Mathieson, 1970; Sears & Wilce, 1970; Hehre *et al.*, 1970; Adey, 1970; Wilce, 1970; and Mathieson, *et al.*, Nova Hedwigia, in press.

Several important phycological discoveries have resulted from recent intensive field studies. For example, the appearance of *Lomentaria clavellosa* in North America was reported from Massachusetts by Wilce & Lee, 1964; more recently, this species has been found in New Hampshire (Hehre, 1972).

Also from New Hampshire has come the first record of the occurrence of *Halicystis ovalis* along the northeastern coast of North America (Mathieson & Burns, 1970). This raises the larger question: is there a *Halicystis-Derbesia* alternation occurring in nature among the New England populations of these algae, for *Derbesia* is common to the sublittoral of our area (Sears & Wilce, 1970)?

In addition, year-round field studies have established the presence of two rare and monotypic brown algal crusts (*Petroderma maculiforme* and *Porterinema fluviatile*) known previously only from the Arctic, and now recorded for New England from Ipswich, Massachusetts (Wilce, Webber, & Sears, 1970). More specifically, this publication

presents the first report of *Petroderma* in Massachusetts, as well as the first record of the occurrence of *Porterinema* in North America. This latter taxon had been described previously only from the Baltic. For detailed discussions of the morphology, cytology, reproductive periodicities, and geographical distributions of these two "fleshy crusts", the reader is referred to the above paper. A comprehensive updating and summation of both brown and red algal "fleshy crusts" in New England has been presented by Wilce (1971).

Complementing the renewed vigor in research on the algae of the sublittoral zone, recent attention also has been focused on estuaries and their adjacent salt marshes. In New England, particularly, these ecosystems represent promising areas of study for the marine phycologist. Published accounts of the benthic algal vegetation of our salt marshes are few; the majority of species common to such interesting habitats are microscopic, and many, undoubtedly, have been overlooked by previous investigators. Publications relative to New England salt marsh algae are, therefore, recent in their appearance. While such publications are essentially ecologically oriented, they also deal with problems in systematics, life history studies, and polymorphisms of certain of the species encountered. The following papers may be mentioned as examples of recent studies centered about salt marsh ecosystems: Blum, 1960, 1968; Blum & Conover, 1953; Blum & Wilce, 1958; Webber, 1967, 1968, 1971; Webber & Wilce, 1971, 1972; and Mathieson & Fralick, 1972. The works of Drouet (1968) and Blum (1972), although not dealing entirely with New England salt marsh algae, do contain some phycological data applicable to this area.

An even greater void in our understanding of the attached marine algae relates to the autecology of particular species. To date, comparatively few autecological studies have been undertaken. Examples of New England seaweeds in both field and laboratory settings include the following: Kanwisher, 1957, 1966; Conover, 1958; Mathieson & Burns,

1971; Burns & Mathieson, 1972a, 1972b; Fralick & Mathieson, 1972, 1973; and Jordan & Vadas, 1972.

PRELIMINARY SPECIES TABULATION

The species listed in the following tabulation have been collected and examined by me. I acknowledge the advice of Dr. F. Drouet concerning several of the bluegreen algal determinations; Dr. C. van den Hoek for assistance with species of *Cladophora*; Dr. H. W. Johansen for advice on the Coralline algae; and Dr. R. T. Wilce for confirmation of the *Peyssonnelia* determination.

The systematic treatment of the Cyanophycophyta follows that of Drouet and Daily (1956); Drouet (1962, 1963, 1964, 1968); Fan (1956); and Tilden (1910). The treatments of the Chlorophycophyta, Phaeophycophyta, and Rhodophycophyta all essentially follow Taylor (1957), with the following exceptions: van den Hoek (1963) was followed for *Cladophora*, while the recent studies of Bliding (1963, 1968) were consulted for the Ulvales; species designations in *Ectocarpus* are after Rosenvinge & Lund (1941) and Cardinal (1964), *Petroderma* follows Waern (1952), and Powell's study (1957) was used for *Fucus*, and that of Wilce (1965) for *Laminaria*. The Chrysophycophyta (excluding diatoms) are treated in this paper following Taylor (1957) for the Vaucheriales, and Parke and Dixon (1968) for the Ochromonadales.

Cyanophycophyta

- Anabaena torulosa* (Carm.) Lag.
- Calothrix crustacea* (Thur.) Fan
- Coccochloris stagnina* Spreng.
- Entophysalis deusta* (Menegh.) Dr. et D.
- Lyngbya lutea* (Ag.) Gom.
- Microcoleus chthonoplastes* Thur.
- M. lyngbyaceus* (Kütz.) Crouan
- M. vaginatus* (Vaucher) Gom.
- Nodularia harveyana* (Thwaites) Thur.
- N. spumigena* Mert.

Chlorophycophyta

- Blidingia minima* (Näg. ex Kütz.) Kylin
Brachiomonas sp.
Bryopsis plumosa (Huds.) C. Ag.
Capsosiphon fulvescens (C. Ag.) S. et G.
Chaetomorpha linum (Muell.) Kütz.
C. melagonium (Weber & Mohr) Kütz.
Chlorochytrium moorei Gardner
Cladophora albida (Huds.) Kütz.
Codiolum gregarium A. Br. f. *intermedium* (Fos.) Collins
Enteromorpha flexuosa (Wulfen ex Roth) J. Ag.
E. intestinalis (L.) Link
E. intestinalis (L.) Link f. *clavata* J. Ag.
E. linza (L.) J. Ag.
E. linza (L.) J. Ag. var. *oblanceolata* Doty
Percursaria percursa (C. Ag.) Bory
Prasinocladus lubricus Kuck.
Prasiola stipitata Suhr
Rhizoclonium tortuosum Kütz.
Spongomorpha arcta (Dillw.) Kütz.
S. lanosa (Roth) Kütz.
S. spinescens Kütz.
Ulothrix flacca (Dillw.) Thur.
Ulva gigantea (Kütz.) Bliding

Phaeophycophyta

- Agarum cribosum* (Mert.) Bory
Alaria esculenta (L.) Grev.
Ascophyllum nodosum (L.) Le Jolis
Asperococcus echinatus (Mert.) Grev.
Chorda filum (L.) Stack.
Chorda tomentosa Lyngbye
Chordaria flagelliformis (Müll.) C. Ag.
Corynophlaea sp.
Desmarestia aculeata (L.) Lam.
D. aculeata (L.) Lam. var. *attenuata* Taylor
D. viridis (Müll.) Lam.

- Dictyosiphon chordaria* Aresch.
D. foeniculaceus (Huds.) Grev.
Ectocarpus confervoides var. *confervoides* (Roth) Kjellm.
E. confervoides var. *siliculosus* (Dillw.) Kjellm.
E. fasciculatus (Griff.) Harv.
Elachistea fucicola (Vell.) Aresch.
Fucus distichus L. ssp. *edentatus* (de la Pyl.) Powell
F. distichus L. ssp. *evanescens* (C. Ag.) Powell
F. vesiculosus L.
Laminaria saccharina (L.) Lam. sensu Wilce
L. digitata (Huds.) Lam.
Leathesia difformis (L.) Aresch.
Petalonia fascia (Muell.) Kuntze
Petroderma maculiforme (Woll.) Kuck.
Pylaiella littoralis (L.) Kjellm.
Ralfsia clavata (Harv. in Hook) Crouan
R. fungiformis (Gunn.) S. et. G.
R. verrucosa (Aresch.) J. Ag.
Scytosiphon lomentaria (Lyngbye) Link
Sphacelaria cirrhosa (Roth) C. Ag.
Streblonema aecidioides (Rosenv.) Fos.

Rhodophycophyta

- Acrochaetium* sp.
Agardhiella tenera (J. Ag.) Schmitz
Ahnfeltia plicata (Huds.) Fries
Antithamnion floccosum (Müll.) Kleen
Asparagopsis hamifera (Hariot) Okamura
Bangia fuscopurpurea (Dillw.) Lyngbye
Ceramium deslongschampii Chauvin var. *Hooperi* (Harv.)
 Taylor
C. rubriforme Kylin
C. rubrum (Huds.) J. Ag.
Chondrus crispus Stack.
Corallina officianalis L.
Clathromorphum circumscriptum (Strøm.) Fos.
Cystoclonium purpureum (Huds.) Batters

- C. purpureum* (Huds.) Batters var. *cirrhosum* Harv.
C. purpureum (Huds.) Batters f. *stellatum* Collins
Dumontia incrassata (Müll.) Lam.
Euthora cristata (C. Ag.) J. Ag.
Gigartina stellata (Stack.) Batters
Gloiosiphonia capillaris (Huds.) Carm.
Gracilaria verrucosa (Huds.) Papenfuss
Hildenbrandia prototypus Nardo
Lithothamnium sp.
Membranoptera alata (Huds.) Stack.
Petrocelis middendorfi (Rup.) Kjellm.
Peyssonnelia sp.
Phycodrys rubens (L.) Batters
Phyllophora brodiaei (Turner) J. Ag.
Phymatolithon laevigatum (Fos.) Fos.
Phymatolithon sp.
Polyides caprinus (Gunn.) Papenfuss
Polysiphonia lanosa (L.) Tandy
P. nigrescens (Huds.) Grev.
P. novae-angliae Taylor
P. urceolata (Lightfoot) Grev.
Porphyra umbilicalis (L.) J. Ag.
Ptilota serrata Kütz.
Rhodocorton purpureum (Lightfoot) Rosenv.
Rhodymenia palmata (L.) Grev.

Chrysophycophyta

- Apistonema* — like plants
Ruttnera sp. (?*maritima* (Anand) Parke)
Urococcus foslieanus Hansgr.
Vaucheria compacta (Collins) Collins

LITERATURE CITED

- ADEY, W. H. 1970. The crustose corallines of the northwestern North Atlantic, including *Lithothamnium lemoinae* n. sp. Jour. Phycol. 6: 225-229.
 BLIDING, C. 1963. A critical survey of European taxa in Ulvales. I. Opera Bot. (Suppl. Bot. Not.) 8: 1-160.

- . 1968. A critical survey of European taxa in Ulvales. II. *Ulva*, *Ulvaria*, *Monostroma*, *Kornmannia*. Bot. Not. **121**: 535-629.
- BLUM, J. L. 1960. A new *Vaucheria* from New England. Trans. Amer. Micros. Soc. **79**: 298-301.
- . 1968. Salt marsh Spartinas and associated algae. Ecol. Monogr. **38**: 199-221.
- . 1972. Vaucheriaceae. No. Am. Flora. II. **8**: 1-64.
- , & J. T. CONOVER. 1953. New or noteworthy Vaucheriae from New England salt marshes. Biol. Bull. **105**: 395-401.
- , & R. T. WILCE. 1958. Description, distribution, and ecology of three species of *Vaucheria* previously unknown from North America. Rhodora **60**: 283-288.
- BURNS, R. L., & A. C. MATHIESON. 1972a. Ecological studies of economic red algae. II. Culture studies of *Chondrus crispus* Stackhouse and *Gigartina stellata* (Stackhouse) Batters. Jour. Exp. Mar. Biol. Ecol. **8**: 1-6.
- & ———. 1972b. Ecological studies of economic red algae. III. Growth and reproduction of natural and harvested populations of *Gigartina stellata* (Stackhouse) Batters in New Hampshire. *Ibid.* **9**: 77-95.
- CARDINAL, A. 1964. Étude sur les ectocarpacées de la Manche. Nov. Hedw. **15**: 1-86. 41 figs.
- CONOVER, J. T. 1958. Seasonal growth of benthic marine plants as related to environmental factors in an estuary. Inst. Mar. Sci., Univ. Texas. Port Aransas **5**: 97-197.
- DROUET, F. 1962. Gomont's ecophenes of the bluegreen alga *Microcoleus vaginatus* (Oscillatoriaceae). Proc. Acad. Nat. Sci. **114**: 191-205.
- . 1963. Ecophenes of *Schizothrix calcicola* (Oscillatoriaceae). *Ibid.* **115**: 261-281.
- . 1964. Ecophenes of *Microcoleus chthonoplastes*. Rev. Algol. **4**: 315-324.
- . 1968. Revision of the classification of the Oscillatoriaceae. Monogr. **15**. Acad. Nat. Sci., Philadelphia. 370 pp.
- , & W. A. DAILY. 1956. Revision of the coccoid Myxophyceae. Butler Univ. Bot. Studies **12**: 1-218.
- FAN, K. C. 1956. Revision of the genus *Calothrix* Ag. Rev. Algol. N.S. **2**: 154-178.
- FRALICK, R. A., & A. C. MATHIESON. 1972. Winter fragmentation of *Codium fragile* (Suringar) Hariot ssp. *tomentosoides* (van Goor) Silva (Chlorophyceae, Siphonales) in New England. Phycologia. **11**: 67-70.
- & ———. 1973. Ecological studies of *Codium fragile* in New England. Mar. Biol. **19**: 127-132.

- HEHRE, E. J. 1972. *Lomentaria clavellosa* (Turner) Gaillon: an addition to the marine algal flora of New Hampshire. *Rhodora* **74**: 158.
- , J. R. CONWAY, & R. A. STONE. 1970. Flora of the Wolf Islands, Part III: The marine algae. *Ibid.* **72**: 115-118.
- , & A. C. MATHIESON. 1970. Investigations of New England marine algae. III: Composition, seasonal occurrence, and reproductive periodicity of the marine Rhodophyceae in New Hampshire. *Ibid.* **72**: 194-239.
- JORDAN, A. J., & R. L. VADAS. 1972. Influence of environmental parameters on intraspecific variation in *Fucus vesiculosus*. *Mar. Biol.* **14**: 248-252.
- KANWISHER, J. L. 1957. Freezing and drying in intertidal algae. *Biol. Bull.* **113**: 275-285.
- . 1966. Photosynthesis and respiration in some seaweeds. Pp. 407-420 *In*: H. BARNES, (ED.), *Some Contemporary Studies in Marine Science*. George Allen and Unwin Ltd., London.
- LAMB, I. M. & M. H. ZIMMERMANN. 1964. Marine vegetation of Cape Ann, Essex County, Massachusetts. *Rhodora* **66**: 217-254.
- MATHIESON, A. C., & R. L. BURNS. 1970. The discovery of *Halicystis ovalis* (Lyngbye) Areschoug in New England. *Jour. Phycol.* **6**: 404-405.
- & ———. 1971. Ecological studies of economic red algae. I. Photosynthesis and respiration of *Chondrus crispus* Stackhouse and *Gigartina stellata* (Stackhouse) Batters. *Jour. Mar. Biol. Ecol.* **7**: 197-206.
- , & R. A. FRALICK. 1972. Investigations of New England marine algae. V. The algal vegetation of the Hampton-Seabrook Estuary and the open coast near Hampton, N. H. *Rhodora* **74**: 406-435.
- , E. J. HEHRE, & N. B. REYNOLDS. Investigations of New England Marine Algae. I. A floristic and descriptive ecological study of the marine algae at Jaffney Point, New Hampshire. *Nov. Hedw.* (in press).
- , N. B. REYNOLDS, & E. J. HEHRE. Investigations of New England marine algae. II. The species composition, distribution and zonation of seaweeds in the Great Bay Estuary System and the adjacent open coast of New Hampshire. *Ibid.* (in press).
- PARKE, M., & P. S. DIXON. 1968. Check-list of British marine algae — second revision. *Jour. Mar. Bio. Assoc. U. K.* **48**: 783-832.
- POWELL, H. T. 1957. Studies in the genus *Fucus* L. I. *Fucus distichus* L. emend. Powell. *Ibid.* **36**: 407-432.
- ROSENINGE, L. K., & S. LUND. 1941. The marine algae of Denmark. Contributions to their natural history. II. Phaeophyceae. Part I. D. Kgl. Danske Vidensk., Biol. Skrifter., Bd. 1. København.

- SEARS, J. R., & R. T. WILCE. 1970. Reproduction and systematics of the marine alga *Derbesia* (Chlorophyceae) in New England. *Jour. Phycol.* 6: 381-392.
- TAYLOR, W. R. 1937. *Marine Algae of the Northeast Coast of North America*. ix + 427 pp. Univ. Mich. Press. Ann Arbor.
- . 1957. *Marine Algae of the Northeast Coast of North America*. (Revised ed.). viii + 509 pp. Univ Mich. Press. Ann Arbor.
- TILDEN, J. 1910. *Minnesota Algae. I. Myxophyceae of North America*. Minneapolis.
- VAN DEN HOEK, C. 1963. Revision of the European species of *Cladophora*. E. J. Brill. Leiden. 248 pp. + 55 pls.
- WAERN, M. 1952. Rocky-shore algae in the Öregrund Archipelago. *Acta Phytogeogr. Suecica* 30: 1-298. Uppsala.
- WEBBER, E. E. 1967. Bluegreen algae from a Massachusetts salt marsh. *Bull. Torrey Bot. Club* 94: 99-106.
- . 1968. New England salt marsh *Vaucheriae*. *Rhodora* 70: 274-277.
- . 1971. Observations on *Microcoleus lyngbyaceus* (Kütz.) Crowan from marine habitats in New England. *Ibid.* 73: 238-243.
- , & R. T. WILCE. 1971. Benthic salt marsh algae at Ipswich, Massachusetts. *Ibid.* 73: 262-291.
- & ———. 1972. The ecology of benthic salt marsh algae at Ipswich, Massachusetts. I. Zonation and distribution of algal species. *Ibid.* 74: 475-488.
- WILCE, R. T. 1965. Studies in the genus *Laminaria*. Pp. 247-256 *In: Bot. Gothoburgensia. III. Proc. Fifth Mar. Biol. Symposium. Göteborg.*
- . 1970. *Cladophora pygmaea* Reinke in North America. *Jour. Phycol.* 6: 260-263.
- . 1971. Some remarks on the benthic chrysophytes and the fleshy red and brown crusts. Pp. 17-25 *In: Symp. Cold Water Inshore Marine Biology — Some Regional Aspects. Mar. Sci. Inst., Nahant, Mass.*
- , & R. W. LEE. 1964. *Lomentaria clavellosa* in North America. *Bot. Mar.* 6: 251-258.
- , E. E. WEBBER, & J. R. SEARS. 1970. *Petroderma* and *Porterinema* in the New World. *Mar. Biol.* 5: 119-135.

DEPT. OF BIOLOGY
KEUKA COLLEGE
KEUKA PARK
NEW YORK 14478